TERM PROJECT

The behavior of various types of structural members can be described through their moment-curvature relationships.

Develop a computer program that calculates moment, curvature, strain in rebar and strain in concrete for a rectangular cross section throughout the entire range of loading up to failure. The program should be able to handle axial forces acting on the cross section, i.e., columns.

This program will be used to perform parametric studies on concrete beams reinforced with steel and fiber composite rebars; concrete beams strengthened with epoxy bonded fiber composite plates; and concrete columns strengthened for seismic forces with high strength fiber composite wraps.

Four different types of materials will be used in the parametric study: concrete; steel; Glass-Fiber-Reinforced-Plastic (GFRP); and Carbon-Fiber-Reinforced-Plastic (CFRP). These materials have significantly different mechanical properties, i.e. stress-strain relationships. The stress-strain diagrams for all four materials are given on the next page.

The stress-strain curve of the concrete is idealized by the following cubic polynomial:

$$f_c = a\epsilon_c^3 + b\epsilon_c^2 + C\epsilon_c + d$$

where f_c = stress at any point; ϵ_c = strain at any point; $a = -7.2 \times 10^{10}$ psi; $b = -9.2 \times 10^{8}$ psi; $c = 456e350$ psi; and $d = 0.0$.

The stress-strain curve of steel is elastic-perfectly-plastic with a yield stress of 60 ksi and modulus of elasticity of 29,000 ksi. The stress-strain curves of GFRP and CFRP are both linear elastic to failure with tensile strength and modulus of elasticity of 170 ksi, 7.5×10^3 ksi and 350 ksi, and 23×10^3, ksi respectively.

This program will be used to perform a parametric study to investigate the effect of various design variables such as type of rebar, reinforcement ratio, size and area of plate, and size and type of composite warp on the strength and ductility of concrete beams and columns. This will be accomplished through plots of moment vs. curvature and moment vs. strain in concrete, rebar, composite plate, and composite wrap. More details about this project will be provided in class throughout the remainder of the semester.

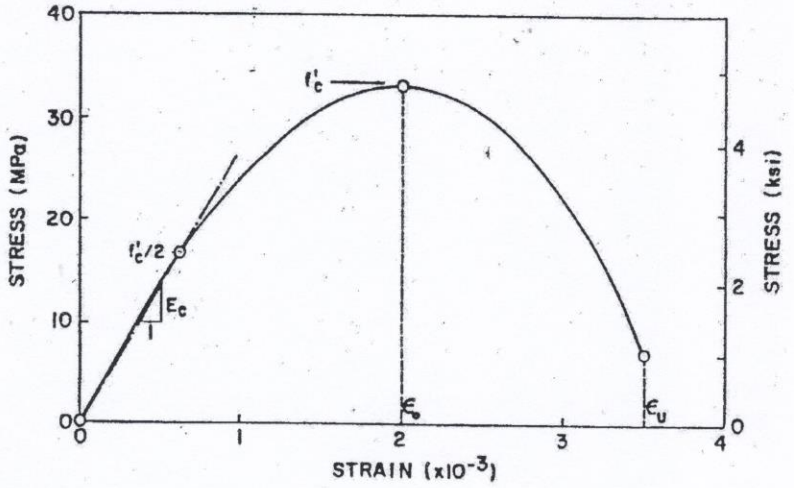

FIG. 1 Idealized Stress-Strain Curve of Concrete

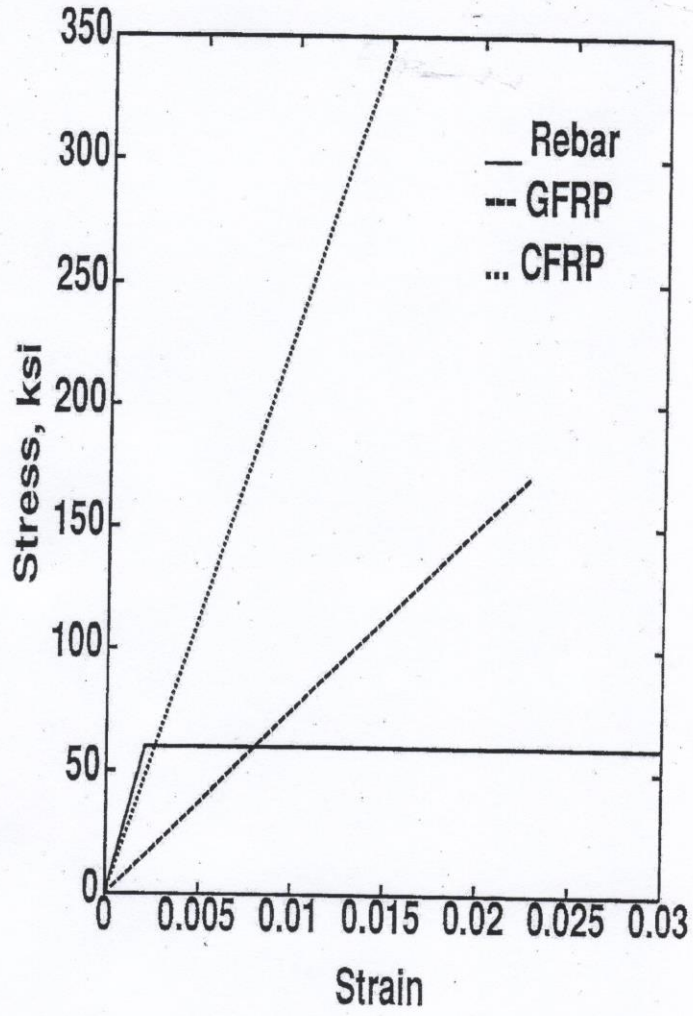

Figure 2 Stress-Strain Curves for Rebar, CFRP and GFRP